Light and Lighting

Official Journal of the Illuminating Engineering Society

Incorporating "The Illuminating Engineer."

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	Page
Editorial Notes ...	37
Notes and News ...	38
I.E.S. Meetings	39
Photometry of Discharge Lamps ...	41
The Arc as a Standard of Light ...	44
N.I.C. Annual Report ...	46
Fluorescent Lighting on The Underground ...	51
The Editor Replies ...	55

Mine Lighting

IF you were asked **"In which Field of Lighting is there Most Need for Improvement?"** What would be your reply?

Some might be inclined to suggest street lighting, for, even in well-lighted streets, the average illumination is but a small fraction, perhaps 1/100th or less, of that customary in factories.

But surely the right answer would be **"In the Mines,"** where workers toil, under most difficult conditions, in semi-darkness, often by an illumination which is only a fraction of that aimed at in streets.

The summary of work initiated by the N.I.C. and reported on pp. 49-50 is therefore opportune. The recommendation made in 1944 that a general illumination of not less than 0.4 L/sq. ft. is endorsed and the possibilities of portable lamps, mains lighting, pneumatic electric lamps, and cap lamps are discussed.

The decision to nationalise the coal mining industry brings with it an urgent obligation to improve working conditions. Lighting should be one of the first items to receive attention.

I.E.S. Convention

The sands are running out, and in the course of a few weeks we shall be gathering for the I.E.S. Convention, of which members have already received the provisional programme. By the time these words appear, or shortly after, they will all be receiving the second and final notice. We have been asked to make it clear that all members proposing to attend the Convention should be careful *to fill up and return forms asking for tickets for the various social events.* As previously explained, the data asked for in the preliminary notice were intended only as a guide to probable attendance. Members who stated their intention then of applying for tickets *must not fail to complete the forms in the final notice,* sending remittances to cover the cost of tickets where necessary. For certain events—notably the Informal Social Evening on May 16—it will probably be necessary to restrict the attendance—probably by accepting applications in order of date, and it may also be necessary to limit the number of guests brought by each member. We hope that I.E.S. members from the provinces will all make a special effort to attend. In conclusion, it might perhaps be said that the organisation of a Convention in present circumstances is a rather bold step. Recovery towards the normal has, in fact, not been so rapid as had been hoped. If therefore the organisation and entertainment should in some respects fall short of what would have been expected in pre-war days, members will sympathise and understand.

Industrial Hygiene

We note with interest the organisation, at the London School of Hygiene and Tropical Medicine, of a three-day course of lectures and demonstrations on Applications of Physiology to Engineering Problems in Industry (March 18-20). The course was prepared primarily for engineers from industry; working conditions, lighting, heating, ventilation and dust being all discussed and illustrated by a special visit to the Home Office Industrial Museum. One is glad to note that it is becoming customary to include lighting in courses of this nature. One way or another the School is doing good work in bringing this subject to the notice of many sections of the community by whom it might otherwise be overlooked.

Stage Lighting

From all accounts Mr. L. G. Applebee's recent address on this subject to the I.E.S. Manchester Centre was a great success. The lecturer was in fine form and put over his subject in his inimitable manner to an enthusiastic audience numbering over 150. The Manchester Centre seems indeed to have maintained its audiences well during the present session. We understand that, apart from the occasion when Mr. Aldington gave his paper—to what must have been a record attendance of 180—numbers have never been less than 50. In Liverpool, we believe, experience has also been good; in fact there seems to be plenty of enthusiasm in the North-West.

Forthcoming I.E.S. Meetings

(Provisional List)

SESSIONAL MEETINGS IN LONDON

1946.

April 17th. MR. W. R. STEVENS and MR. S. S. BEGGS on **A Specimen Lecture, for Delivery in Schools,** on **"Light and Your Eye."** (*Joint Meeting with the Science Masters' Association, to be held in the Imperial College of Science, S. Kensington.*) **5.30 p.m.**

I.E.S. CONVENTION*

May 15th. Annual General Meeting, followed by Addresses on **Lighting during the War and After** and **Light and Health. 10 a.m.**
MR. L. J. DAVIES on **New Lamps for Old. 2.30 p.m.**

May 16th. MR. W. R. STEVENS and MR. J. M. WALDRAM on **Laboratory Techniques for Solving War-time Visibility Problems. 10 a.m.**
DR. S. ENGLISH on **The Lighting of Airports. 11.30 a.m.**

MR. W. J. JONES on **Fluorescent Lighting Practice. 3.30 p.m.**
MR. W. A. ALLEN on **Daylight and Town Planning. 2 p.m.**

(*All Convention Meetings will take place in the Lecture Theatre of the Institution of Electrical Engineers, Victoria Embankment, London, W.C.*)

MEETINGS OF CENTRES AND GROUPS

1946.

April 4th. Factory Lighting and Special Problems. (*At Bridgend.*) **3.15 p.m.**

April 4th. DR. J. H. SHAXBY on **Colour and the Eye.** (*At Reynolds Hall, College of Technology, Sackville Street, Manchester.*) **6 p.m.**

April 4th. Exhibition on Films. (*At Bradford Electricity Dept. Showrooms, Sunbridge Road, Bradford.*) **6.45 p.m.**

April 5th. DR. DRUMMOND CURRIE on **Vision and the Eye.** (*At Electricity Showrooms, Bath.*) **7.0 p.m.**

1946.

April 5th. Address by DR. S. ENGLISH. (*At Imperial Hotel, Temple Street, Birmingham.*) **6 p.m.**

April 5th. Annual General Meeting. (*At Heriot-Watt College, Chambers Street, Edinburgh, 1.*) **6 p.m.**

April 5th. MR. R. GILLESPIE WILLIAMS on **Modern Stage and Colour Lighting.** (*At Lecture Theatre, City of Nottingham Gas Dept., Parliament Street, Nottingham.*) **5.30 p.m.**

April 8th. MR. J. S. PRESTON on **Photometry in Theory and Practice.** (*At Sheffield University, Western Bank, Sheffield.*) **6 p.m.**

April 18th. Lecture on Gas Applications. (*At Cheltenham.*)

April 25th. Annual General Meeting and Luncheon. (*Park Hotel, Cardiff.*)

April 29th. Address by the President (MR. H. C. WESTON). (*At Sheffield University, Western Bank, Sheffield,* 10.) **6 p.m.**

April 30th. Annual General Meeting. Address by the President (MR. H. C. WESTON). (*At Electricity Showrooms, The Headrow, Leeds.*) **6 p.m.**

May 1st. MR. W. HARRISON on **Colour and its Measurement—A new Colorimeter.** (*At Liverpool Corporation Electricity Showrooms, Whitechapel, Liverpool.*) **6.0 p.m.**

May 3rd. Annual General Meeting (Chairman's Review). (*At Radiant House, Bristol.*) **7.0 p.m.**

May 3rd. Debate. **That Works Engineers Should Plan Their Own Lighting Schemes.** (*At Imperial Hotel, Temple Street, Birmingham.*) **6.0 p.m.**

May 7th. Annual General Meeting. (*In the Demonstration Theatre of the City of Leicester Electricity Dept., Charles Street, Leicester.*) **6.0 p.m.**

May 7th. MR. H. L. WALKER on **Vision.** (*At Electricity Showrooms, Market Street, Huddersfield.*) **7.0 p.m.**

May 16th. Visit to **Gloucester or Cheltenham Gas Works.** (*Afternoon.*) (*Evening.*) **Annual General Meeting.**

* For Social Events *see* Detailed Programme.

(Secretaries of Centres and Groups are requested to send in particulars of any changes in programmes, mentioning subject, author, place, date and time of meeting; summaries of proceedings at meetings (which should not exceed about 250-500 words) and any other local news are also welcome.)

N.I.C. Annual Report

The annual report of the National Illumination Committee, reproduced on pp. 46-48, refers to the retirement from the chairmanship, previously noted in these columns, of the Earl of Mount Edgcumbe, whose place has now been taken by Dr. J. W. T. Walsh. It also contains encouraging evidence of the zest with which the Committee has resumed work and of useful researches in quite a number of fields. Of these, the investigation of mine lighting (see pp. 49-50) is of major importance. It is also interesting to note that some approach is being made to other countries interested in the I.C.I. It has now been learned that a limited edition of part of the I.C.I. 1939 proceedings has been printed in Vienna, but apparently the available copies are still in cold storage there.

Materials for Road Surfaces

An interesting note in the *Standards Review*, the organ of the British Standards Institution, deals with materials for roads, such as asphalt, concrete, tar and tarmacadam and aggregates, which have been studied in detail at the N.P.L. and have been the subject of a number of specifications. The wearing power of the product and its non-skid qualities may be affected by apparently small variations in material or preparation, not only in the case of new roads but for those in which surfacings or carpets are applied. One interesting point is that aggregates should consist of particles that are cubical and not flaky. The three materials named are usually regarded as alternatives, in much the same class so far as mechanical properties are concerned. From the lighting standpoint, however (even granted that modern technique can make good use of dark but shiny surfaces), a light-coloured surface such as cement is greatly to be preferred. Research on aggregates might well take into consideration the light-reflecting qualities of the product. Is it even conceivable that research might yield us ultimately a light-coloured tar?

Lectures to Children in Cardiff

During recent years the I.E.S. has devoted considerable attention to the organisation of lectures to schoolchildren on lighting, which have proved very successful both in London and elsewhere. Various I.E.S. Centres have interested themselves actively in this project. We now learn from Mr. S. G. Turner that a series of six lectures, spread over April 15-17, is to be given to children from about seven Cardiff schools. The ages of the children are from 13 to 16 and the total attendance definitely secured will be at least 1,000. The Centre has been very fortunate in inducing Mr. R. O. Ackerley to undertake these lectures and the Lord Mayor of Cardiff has promised to open the first lecture and to give the series a good send-off.

Social Events

It has always seemed to us that the social side of the I.E.S. activities should be fostered. In London, during the war at least, little has been done in this respect, and even now provision for any but small parties presents difficulties. The Centres have been, on the whole, rather more successful in this respect. We have before us the announcement of the first annual luncheon of the Cardiff Centre, to take place at the Whitehall Rooms of the Park Hotel on April 25, to be followed immediately by the annual general meeting. We also note that the social evening and dance arranged by the Nottingham Centre on March 8 at the Trent Bridge Hotel was a great success, about 80 members and friends being present.

The Photometry and Colorimetry of Electric Discharge Lamps

Summary of a paper read by Mr. G. T. Winch before the Illuminating Engineering Society at their Sessional Meeting held in London on March 11th, 1946.

Although the subject matter of this paper was in parts somewhat abstruse it attracted an excellent audience in the lecture theatre of the Institution of Mechanical Engineers, and was heard with close attention. Although the paper itself is necessarily of a somewhat formidable length, Mr. Winch wisely contrived to keep the delivery, and the many clever demonstrations which accompanied the paper, well within the hour.

In the early days of electric discharge lamps various fairly accurate but laborious methods of overcoming the difficulties involved in comparisons of lamps yielding light of various tints were contrived. Owing, however, to the wide range of lamps now available these colour problems have been accentuated. In addition there are certain special difficulties associated with the latest fluorescent lamps, such as their great length, the care necessary to ensure stability, etc., to which Mr. Winch alluded in the final portion of his address.

The "Dispersion and Mask" Process

After reviewing progress from visual to photoelectric heterochromatic photometric technique following the C.I.E. recommendations, Mr. Winch recalled the conception of the "C.I.E. average eye," and described in considerable detail the design and performance of new dispersion and mask type of apparatus—an improvement on the original instrument described by the author and a colleague before the Society in 1940. By dispersing the light from the test source, arranging in the spectral image plane a suitably shaped mask and then recombining the light on to a photocell, any desired spectral response can be accurately realised. This dispersion and mask method enables not only the lumens of lamps to be measured but in addition, and in quick succession, the C.I.E. trichromatic coefficients of the source and the colour rendering properties in terms of the luminosity in eight agreed spectral bands or colour bands. This facility is of great value in appraising electric discharge lamps. It is hoped also to be able to apply the same technique to reflected light from coloured materials. Mr. Winch demonstrated the process very aptly and he enumerated no fewer than eleven design requirements which his new apparatus is prepared to fulfil.

A New Universal Photoelectric Photometer

These requirements are met in the universal photoelectric photometer which, with its control cabinet and 5-ft. spherical integrator, was illustrated by Mr. Winch. The optical system of the apparatus, the photoelectric measuring system, and the method of preparing the mask to provide an overall spectral sensitivity the same as that of the C.I.E. average eye were described very fully. Mr. Winch also referred to some subsidiary difficulties such as the effect on the apparatus of variations in temperature, which were ultimately overcome by the enclosure of the photocell photometer unit within a constant temperature envelope.

Some illustrations of the accuracy of the apparatus, e.g., in approaching the C.I.E. average eye and in terms of the trichromatic coefficients of light transmitted by filters, were given. In regard to

practical lumen measurements, results so far indicate an accuracy within about 3 per cent. (plus or minus).

Measurements of Discharge Lamps

After describing some new attempts to achieve average eye response by cell-filter combinations, Mr. Winch passed on to the problem of chief interest to most of those present, measurements on electric discharge lamps. After discussing the characteristics of electrical measuring instruments and their assembly in circuit, which led to the application of a thermionic wattmeter to the problem, the author referred to certain features of lamps which call for care in making measurements. There is, for example, the time required to achieve stabilisation, which may be 15 minutes for HPMV types and as much as 45 minutes for sodium lamps; whereas with neon lamps stabilisation is practically instantaneous. In the case of tubular fluorescent lamps it is also necessary to guard against the disturbing effects of draughts, which may cause local cooling and so affect the lamp's performance. All lamps should be tested at one ambient temperature, e.g., 20 C., or allowance made for the difference.

It is interesting to note that although these lamps fall in output considerably during life, and especially during the initial 100 hours, there does not seem to be any appreciable alteration in the *colour* of the light.

Departure from the Inverse Square Law

The author dealt in a very interesting manner with one familiar photometric problem—the extreme departure from the theoretical point-source of the 5 ft. tube which makes ordinary photometric methods so difficult to apply. In particular there is the question how far measurements of lumens with the 5 ft. photometric integrators (the limiting size available in most laboratories) can be trusted. It is, in any case, only just possible to operate the lamps in apparatus of this size.

It was decided to check such results with those obtained from polar distribution measurements. Here a new difficulty arises. In order that the inverse square law may hold, the distance from lamp to photometer should be at least *ten times* the length of the source—a distance too great to be practicable. Ultimately a visual method, involving a special photometer head which was fully exposed to the light from the entire length of tube, however situated, was adopted, the lamp being situated at a fixed distance of 10 ft. from the photometer head. The polar measurements so obtained were not the true values which would be obtained at ten times the distance. *But for the purpose of determining lumens this does not matter,* provided the test plate (in this case a specially prepared smoked magnesia plate) obeys the cosine law.

The absorption of light, in the sphere, of new 5 ft. lamps was found to be about 2-3 per cent., which usually increases through life to about 5 per cent. By making allowance for this reasonably accurate measurements may be made.

The possibility of making measurements in box integrators, e.g., in a type 6 ft. by 2 ft. by 2 ft., was also explored. Differences amounting, in extreme cases, to as much as 8 per cent. were noted. It was found, however, that these could be substantially reduced by painting the inside of the integrator a matt grey with a reflection factor in the region of 50 per cent.

The "Colour Temperature"

In conclusion, the author referred to several other problems, such as the measurement of illumination from tubular fluorescent lamps at low mounting height, which has recently been discussed by C. A. Morton ("Light and Lighting," November, 1945, p. 157), and to errors which arise if the colour of tubular fluorescent lamps is stated as a "colour temperature." Although the spectral distribution of some classes of fluorescent lamps does approximate to that of a black body in the visible spectrum, others differ appreciably. Thus neither the "daylight" nor the "warm white" lamps, when plotted on the C.I.E. trichromatic system, are actually on the black body locus, and in the latter case the departure is so great that no temperature could be assigned to it.

Measuring Lumen-Output From Very Large Sources

(*Communicated*)

There has been, for some little time, uncertainty about the possibilities of existing integrating photometers for measuring light-output from very large sources.

The 5 ft. fluorescent tube presents an obvious difficulty. It comes as a relief (and something of a surprise) to learn that such a lamp can apparently be tested pretty accurately in an integrating sphere 5 ft. in diameter, into which it can only just be fitted. Evidently a 5 ft. tube cannot be tested in a 3 ft. sphere, which is more likely to be available than the 5 ft. variety. But, apparently from Mr. Winch's recent paper (see pp. 41-42), very fair results can be obtained from an integrator box of dimensions 6 ft. by 2 ft. by 2 ft.

In this case the accuracy was improved by diminishing the reflection factor of the inner coating to about 50 per cent., and it would seem that similar measures are likely to prove helpful whenever the foreign body, i.e., the lamp inserted, is of substantial size in relation to the dimensions of the integrating chamber. This, again, seems a rather surprising conclusion when one considers the extreme efforts made to obtain a dead-white material for the interior of the integrating sphere with a reflecting power approaching near to 100 per cent.!

Such experiences rather lead one to the conclusion that for practical measurements of lumen-output, and especially for tests of light sources of considerable area and bulk, too much has been made of the need for great exactitude in the shape and material of integrating photometers. Is it not possible that such measurements are best made in an empty room of moderate size, or a portion of a room partitioned off, provided a *fairly* light-coloured and reasonably neutral coating can be applied to walls and ceiling, and if possible also to the floor?

It seems likely that in the near future we shall have to deal mainly with large sources, not merely fluorescent lamps in various shapes and sizes, but perhaps complicated fittings consisting of combinations of tubes and filament lamps making partial use of reflection from extensive reflecting areas, of which we shall need to know the lumen-output as a combination. Another factor that may well lead to the design of bigger fittings housing high candlepower lamps is the development during the war of serviceable plastic materials with a translucency approaching that of glass but very much lighter. From such materials diffusing bowls of diameter very much greater than that customary at present might well be constructed.

For all such sources a section of a room, rather than a box of relatively small dimensions, might prove the best solution.

Night Flying Training and Sodium Light

A feature in the second world war was the unprecedented importance attached to night operations. The behaviour of the eye at very weak illuminations, in almost complete darkness, became the subject of interest, both for the Forces and for civilians. In particular it was of vital importance for night-flying operations, for which special methods of training, under daylight conditions, were devised. One interesting device, recently demonstrated at the Empire Flying School at Hullavington (Wilts.) and described in "The Times" is based upon the use of complementary colours. According to this system sodium light sources, yielding monochromatic yellow light, are used to illuminate the dials of instruments in the plane and likewise for the landing lights at the aerodrome being approached The pupil pilot wears goggles equipped with a special filter, through which only sodium light passes. He can, therefore, only see the two sets of objects on which he should concentrate, whereas the instructor at his side, without coloured glasses, has practically normal vision.

The Carbon Arc as a Standard of Light and Radiation

I.E.S. members will recall that Professor MacGregor-Morris when president gave a delightful address reviewing some of his researches on the carbon arc, very fittingly delivered at the Royal Institution. On that occasion the author referred only incidentally to his long sustained studies of the arc as a standard of light, a conception previously explored by Mr. A. P. Trotter, Professor Blondel, Mrs. Hertha Ayrton, and others.

It is not surprising that the possibilities of the carbon arc as a standard of light should have proved attractive. One can get by this means a source nearly approaching a point of great brilliancy and yielding what deserves to be described as a "white light." In the past photometrists may have been deterred by the belief that the performance of such a standard is too uncertain and dependent on too many variables. But the position is different to-day when such points as the choice and arrangement of carbons, the desirable current density and the elimination of wandering crater, hissing, etc., are better understood. The work of Professor MacGregor-Morris has shown that all such factors can be controlled. A well-informed and careful user of such a standard might expect to maintain an accuracy in the vicinity of 1-2 per cent., which for all ordinary purposes is enough.

The control of such a source is exceptionally easy. On the other hand, the source of light based on molten platinum, whilst doubtless furnishing the most exact and reproducible primary absolute standard, does involve expensive and intricate apparatus, and needs very careful and expert control. It is in fact unlikely to come into use except in those laboratories charged with the maintenance of the international standard, such as the National Physical Laboratory in this country and the Bureau of Standards in the United States.

As a general standard for use in research laboratories, therefore, the carbon arc has advantages, not only in a photometric sense, but as a standard of radiation.

Its advantages were recently set forth by H. G. MacPherson* as follows:—

(1) It provides a source of reproducible intensity and spectral energy distribution. This reproducibility is independent of time, since it depends only on the physical properties of a pure element. Thus intensity measurements made by Otto Lummer in 1914 are still readily intelligible to-day despite possible changes in light units and radiation constants, because they are expressed on a scale relative to the brightness of a carbon arc.

(2) The reproducibility of the source can be maintained regardless of errors in current and voltage measuring devices. The proper current to obtain uniform brightness can be adjusted merely by watching an image of the arc, without an ammeter in circuit.

(3) The arc provides a much more intense source of continuous radiation than the tungsten lamp. The continuous spectrum is strong enough so that it may be used to obtain absorption spectra in the ultraviolet photographically, as well as to provide a good source for the visible and infra red.

These are strong claims for consideration, and the possibilities of the arc in this connection may be commended to laboratories interested in photometry, spectrographic research and the study of radiation from modern light sources.

* Journal of the Optical Society of America. Vol. 30, No. 5, 189-194. May, 1940.

The Theory of Light Absorption

At the meeting of the Colour Group, held at the Science Museum on March 13, Mr. E. J. Bowen, M.A., F.R.S., gave a very interesting lecture on the wave-mechanical theory of light absorption. The subject was a somewhat difficult one and mostly unfamiliar to the majority of the audience, but Mr. Bowen's clarity of explanation, his slides, and his happy knack of exemplification made most of those present feel that they could at least form a useful idea of the process of light absorption and the way in which it fitted into the modern theory of molecular structure.

First of all, Mr. Bowen explained that the electrons in atoms should be pictured, not as particles revolving in fixed orbits, as postulated by Bohr, but as vibration patterns with nodes exactly analogous to the patterns familiar to us in ordinary three-dimensional vibrations. He then introduced the idea of the molecule, and described how, in simple molecules such as ethylene, the qualitative mutual arrangements of the nodal planes of the electrons could be derived from those of the constituent atoms. Naturally, as the molecule contained more and more atoms, the arrangement became more complicated.

Mr. Bowen then turned to the question of what happened when an atom absorbed a quantum of light energy. This, he said, changed the vibration pattern of one electron and created a new nodal surface which was at right angles to the electric vector of the light. From this it followed that there was a directional effect in light absorption. For any one molecule, the absorption would depend on the plane of polarisation of the light and, consequently, if all the molecules in a substance were arranged in the same way, as in a crystal, there would be a directional effect and the crystal would show what was termed "dichroism."

For most substances the absorption bands occurred at very short wavelengths, far into the ultra-violet, but in certain cases the absorption was in the visible, and therefore produced a coloration of the material. In some substances the absorption of light produced a modification of the structure of the molecule, and this might be accompanied by an alteration in the position of the absorption band.

This remark of the lecturer caused Dr. Wright to ask, in the discussion, whether the change in position of the absorption band consequent on light absorption might provide a possible explanation of the change from rod to cone vision. The former was known to depend on visual purple, a chemical substance which had an absorption curve almost indentical with the visibility curve of the dark-adapted eye. Seach had been made for a similar substance, surrounding the cones, which might be a factor in day vision and would therefore be expected to have an absorption curve similar to that of the light-adapted eye. Dr. Wright asked whether it was possible that when visual purple absorbed light (as the eye became light-adapted) it might change into a substance having the absorption band required for normal light-adapted vision. The lecturer explained that the molecule of visual purple had a somewhat complicated structure; he did not rule out the possibility, but the impression he gave to the audience was that he felt there were objections to the theory.

This experiment of the Colour Group in having a specialist lecturer to introduce to its members a highly abstruse subject of great importance in the theory of light was fully justified by the size of the audience and by the interest evidenced by the subsequent discussion.

National Illumination Committee of Great Britain

(Affiliated to the International Commission on Illumination)

Constitution of the Committee on December 31st, 1945

NOMINATED BY THE CONTRIBUTING ASSOCIATIONS:—

Illuminating Engineering Society: DR. H. BUCKLEY, P. V. BURNETT, J. S. DOW, PROFESSOR T. DAVID JONES, L. H. MCDERMOTT.

Institution of Electrical Engineers: R. O. ACKERLEY, P. GOOD, PROFESSOR J. T. MACGREGOR-MORRIS, DR. C. C. PATERSON, J. W. TOWNLEY.

Institution of Gas Engineers: A. M. BELL, J. E. DAVIS, A. G. HIGGINS, W. HODKINSON, F. C. SMITH.

NOMINATED BY THE CO-OPERATING ASSOCIATIONS:—

Admiralty: J. ROSEN.

Air Ministry: C. B. COLLINS, A. S. MIERS.

Association of Public Lighting Engineers: E. J. STEWART.

British Commercial Gas Association: D. CHANDLER.

British Electrical and Allied Manufacturers' Association: C. RODGERS.

British Electrical Development Association: V. W. DALE.

British Gas Council: A. M. BELL.

Department of Scientific and Industrial Research: (*National Physical Laboratory*) T. SMITH, DR. J. W. T. WALSH.

Electric Light Fittings Association: G. CAMPBELL, DR. S. ENGLISH.

Electric Lamp Manufacturers' Association: W. J. JONES, C. W. SULLY.

Glass Manufacturers' Federation: E. J. C. BOWMAKER, G. MARCHAND.

Incorporated Municipal Electrical Association: J. ECCLES.

Industrial Health Research Board: H. C. WESTON.

Institution of Municipal and County Engineers: E. J. ELFORD.

Medical Research Council: PROF. H. HARTRIDGE.

Ministry of Health: A. SCOTT.

Ministry of Labour and National Service: E. W. MURRAY.

Ministry of Supply: MAJ.-GEN. A. W. SPROULL.

Ministry of War Transport: DR. H. F. GILLBE.

Ministry of Works: G. SMITH.

Post Office: DR. C. G. ROBERTS, W. T. GEMMELL.

Railway Clearing House: A. CUNNINGTON, E. MORGAN.

Society of British Gas Industries: R. J. ROGERS, H. R. STEVENSON, CRAWFORD SUGG.

Society of Glass Technology: DR. B. P. DUDDING.

OFFICERS:—

Chairman: DR. J. W. T. WALSH.

Vice-Chairmen: DR. C. C. PATERSON and F. C. SMITH.

Hon. Treasurer: Dr. C. C. PATERSON, Research Laboratories of the General Electric Co., Ltd., Wembley, Middlesex.

Hon. Secretary: L. H. MCDERMOTT, Ministry of Works, 57, Onslow Gardens, S.W.7.

Representatives of Great Britain on the Executive Committee of the International Commission on Illumination:—

DR. J. W. T. WALSH and DR. H. BUCKLEY.

ANNUAL REPORT FOR THE YEAR 1945

(Presented at the Annual Meeting of the Committee held on Tuesday, March 12th, 1946)

With the gradual resumption of normal activities now in progress, numerous changes of membership have taken place during the year. The most important of these concerns the Earl of Mount Edgcumbe, who has felt obliged to resign from the Committee because of the pressure of other duties. This resignation has broken an association which began when Lord Mount Edgcumbe was nominated to represent the Institution of Electrical Engineers at the inception of the Committee in 1913. He became Vice-Chairman in 1919 and the Chairman in the following year. His place has been taken by Dr. J. W. T. Walsh, who himself has been a member since 1921.

It is with regret that the Committee has to report the passing of Mr. George Dixon, who has represented the Institution of Gas Engineers and the British Gas Council since 1939.

The changes in membership which have taken place are indicated in the following table:—

Organisation	*Representative* Dec., 1944	Dec., 1945
Illuminating Engineering Society	R. O. Ackerley	P. V. Burnett
Institution of Electrical Engineers	Lord Mount Edgcumbe	R. O. Ackerley
Institution of Gas Engineers	G. Dixon Dr. E. V. Evans	A. M. Bell A. G. Higgins
Admiralty	W. C. M. Couch	J. Rosen
Air Ministry	M. Latin	A. S. Miers
British Gas Council	G. Dixon	A. M. Bell
Home Office	E. W. Murray	None
Incorporated Municipal Electrical Assn.	E. J. Jarvis	J. Eccles
Ministry of Labour & National Service	None	E. W. Murray
Ministry of Supply	Col. Silvester Evans	Maj.-Gen. A. W. Sproull
Ministry of War Transport	E. S. Perrin	Dr. H. F. Gillbe
Post Office	Sir Henry Bashford H. W. Fulcher	Dr. C. G. Roberts W. T. Gemmell
Railway Clearing House	M. G. Bennett	E. Morgan

Considerable activity has taken place in connection with the subject of Mine Lighting. Panels of the Sub-committee have prepared reports on Portable Lamps, Mains Lighting and Pneumatic Electric Lamps, which will be incorporated in a Report dealing with the present position regarding mine lighting, for subsequent presentation to the Committee: included in this will be an appendix dealing with the physical properties of glass and organic plastics and their suitability for use in miners' lamps.

As the Committee acts as International Secretariat for the subject of Light Sources, information regarding recent developments is now being collected.

The guide to Aerodrome Lighting is being revised, and as soon as this has been finally approved, the Sub-committee is proceeding to prepare specifications for a number of the items referred to in the guide.

The Sub-committee which has been considering the co-ordination of the various specifications for colours for aerodrome lighting, lighthouse purposes, railway signals and traffic control signals has made good progress and the draft specification should be available for comment soon.

At the request of the Engineers' Department, Trinity House, a specification for electric filament lamps for lighthouse and cognate beam projection apparatus is being prepared; it covers seven different filament shapes, i.e., vertical filaments, single and double cruciform filaments, bunch filaments, cylindrical and multiple-cylindrical filaments and horizontal coil filaments.

The draft specification for Street

Lighting has been circulated and the comments received are being considered.

A draft specification for Reading Lamps—an expansion of B.S. 710—is in course of preparation; it will include piano lighting and floor standards.

At the request of the Electric Lamp Manufacturers' Association, a schedule of dimensions of projection lamps is under consideration. It is intended that this should refer only to dimensions and not to any other properties of the lamps.

A draft specification for Well Glass Fittings for General Illumination is in course of preparation and will soon be available for circulation for comment.

A proposal to revise B.S. 324 and 364, dealing with the neck dimensions of lighting fittings, is at present receiving the attention of the manufacturers.

The following British Standards have been issued or revised during 1945: B.S. 354 (Photometric Integrators), B.S. 230 (Portable Photometers —visual type), B.S. 667 (Portable Photometers — photoelectric type), B.S. 1050 (Visual Indicator Lamps) and B.S. 1270 (Schedule for Electric Discharge Lamps). The first three are those which have been revised.

With regard to the activities of the International Commission, a limited edition of part of the 1939 Proceedings was printed in Vienna, and copies which, under normal conditions, would have come to this Committee have been stored there. The President, Dr. N. A. Halbertsma, has paid several visits to this country and the Central Bureau has re-established contact with the Czechoslovak, Dutch and French National Committees, whilst members of the Belgian and Polish Committees have also visited this country. The Committee learned with regret of the death in December of Prof. Charles Fabry, who was President of the International Commission at the 1939 meeting.

J. W. T. WALSH, Chairman.

Standardisation Abroad

International action in connection with standardisation, naturally impeded during the war period, is obviously very desirable, and it is interesting to learn of developments abroad. In the "Standards Review" we note reference to the recent visit of Sir Percy Ashley (whose subsequent death is noted with regret) to the Antipodes. There he was able to make contact with the Standards Association of Australia, whilst in the case of the New Zealand Standards Institute, which is a Government Department, he was invited to meet members of the Advisory Council in Government House.

The functions of the Standards Institution have been the subject of a discussion in the South African Parliament, where standardisation by means of voluntary co-operation and consultation among the people concerned is preferred. It was stated, however, that the work of the Institution will not be hampered by lack of funds and that arrangements are to be made for the establishment of a Council for Scientific Research.

Mention is also made of developments in Eire, where a Building Research Committee has now been formed, in Palestine, whence has come the first bulletin of its Standards Institution, and to South America, where the Argentine Standards Institute has just acquired a home of its own.

It is interesting to note that this is the third occasion, during its short period of existence, on which the Argentine Standards Association has been faced with the problem of seeking larger premises for the proper development of its activities.

Mine Lighting

A Summary of Recent Work Initiated by the National Illumination Committee.

When the work of the National Illumination Committee was resumed soon after the cessation of the war, one of the first subjects to be taken up was that of mine lighting. A strong sub-committee was formed, representative of all the principal firms and organisations interested in the subject, Mr. J. Ivon Graham, of the Colliery Owners' Research Association, being the chairman. This sub-committee at once set about the preparation of a comprehensive report on the subject and divided the work into three sections, forming panels to deal respectively with portable lamps, mains lighting and pneumatic-electric lamps.

The reports of the panels were incorporated by the sub-committee in a very comprehensive document which formed their report to the National Illumination Committee, and this was fully considered and discussed by members of the Institution of Mining Engineers at their annual general meeting on February 6.

Need for Better Lighting in the Mine

The Report was divided into four sections. The first was a general discussion of lighting conditions underground, and referred at length to recommendations of the Technical Advisory Committee appointed by the Minister of Fuel and Power in 1944. This committee was emphatic as to the inadequacy of much present-day mine lighting and recommended an illumination of the order of 0.4 L/sq. ft. in the general working area and the provision of power-fed lights at the coal face. The present Report endorsed these conclusions, but supplemented them with recommendations for the avoidance or limitation of glare. It also emphasised the importance of proper cleaning and maintenance, whatever the system of lighting adopted.

Portable Lamps

The second part of the Report dealt with portable lamps, and made a number of detailed suggestions for improving present practice. In particular, the status and efficiency of lamp-room personnel should be raised. The reintroduction of krypton-filled bulbs was regarded as very desirable, and approval was expressed of the proposed revision of the British Standard Specification in which the life of cap lamps was reduced from 600 to 250 hours (300 hours for the pillar type of lamp) with a corresponding increase in efficiency. The total increase of light expected from this reduction, combined with krypton-filling, was about 35 per cent. A somewhat surprising suggestion was that the possibility of using the electric discharge type of source in portable lamps should be investigated.

Mains Lighting

The third part of the Report, dealing with mains lighting, was a long one, containing, among other things, a description of the various types of lamps available and of the flame-proof fittings in which they could be used. It was stated that 20-watt 24 in. and 15-watt 18 in. lamps were particularly suitable for this work. It was pointed out that perhaps the principal problem in mains lighting at the coal face was the continual forward shifting of the face as work proceeded, and the consequent need to move the fittings with their supply cables, etc. The committee's conclusions were expressed thus: "The factors of degree of illumination and type of lamp are of secondary importance as compared with the mechanical design of the face-lighting equipment, including fitting, cable, and plug attachments, because unless an entirely new design of the face-lighting equipment can be produced which will render it easily practicable to move for-

ward the whole equipment after each working-shift with the least possible damage to the apparatus, it will never become popular, however efficient the illumination it provides.

Pneumatic-Electric Lamps

In Part IV. of the Report the Committee dealt with pneumatic-electric lamps and their use at the coal face. This type of lighting, subject to the same objection as the mains lighting systems, had been used to a very limited extent for some considerable time, but the introduction of the 40-watt mercury vapour lamps was a new development giving the two advantages of (a) about three times the light, and (b) a much more robust bulb with a longer life. Details of this lamp and of its performance underground were given and a comparison was made of the operation costs of mercury-vapour and tungsten filament lamps. One of the objections to this lamp was the amount of glare caused and trials were being made to reduce this by increasing the reflectivity of the roof, pack-walls, etc., by means of a white limestone dust. The conclusion reached in this part of the Report was that if, for normal power purposes, compressed air were everywhere replaced by electricity, it would pay to instal inbye compressors for face-lighting with pneumatic electric lamps.

The Report concluded with four Appendices; one, by Dr. English, dealt with the physical properties of glass and organic plastics and their suitability for use in miners' lamps, while the second gave much statistical information with regard to the numbers of lamps of different types now in use in collieries. The third Appendix gave relevant extracts from Acts of Parliament and statutory regulations dealing with the control of lighting in coal mines, while in the fourth the recommendations regarding lighting in the report of the Reid Committee (the Technical Advisory Committee of the Ministry of Fuel and Power) were quoted in full.

Cap Lamps

In the course of the very long discussion which followed the presentation of the Report, Major Gardner said that he thought the cap lamp would continue to be necessary even if mains lighting were adopted. Dr. Statham referred to the type of cap lamp giving a more or less concentrated beam of light. This was useful when the worker had to be at some distance from the work. Prof. T. David Jones emphasised the desirability of dust suppression from the point of view of lighting.

Exhibition of Mine Lighting Equipment

The meeting of the Institution was followed in the afternoon by an inspection of a very well arranged exhibition of mine lighting equipment staged at the Royal School of Mines, South Kensington, where the Colliery Owners Research Association has its laboratories. In addition to a number of exhibits of lamps and lighting equipment by individual firms, there was an imitation coal face, past which visitors could walk. Examples of the latest methods for lighting from electric mains were shown here and experimental equipment for fluorescent lighting, lighting by means of pneumatic-electric lamps, floodlighting by means of lamps fed from transportable batteries, as well as the latest forms of cap and hand electric lamps were demonstrated. Another very interesting exhibit was an experimental conveyor which could be illuminated alternatively by mercury-vapour, sodium, fluorescent, or tungsten filament lamps. This showed very well the degree of suitability of each of these various sources for the work of separating shale from coal. In an experimental dust tunnel it was possible to demonstrate the reflectivity of different dusts and to show transportable battery lamps giving powerful dust-piercing beams.

Fluorescent Lighting in the Underground

(Communicated)

Experiments in coaches operating between Baker Street and Rickmansworth.

With the ultimate object of providing maximum convenience and comfort for the travelling public, the London Passenger Transport Board have been conducting a series of experiments during the past few months in the design of underground trains. These experiments recently reached fruition in the shape of a new coach which was put into service on the Metropolitan line between Baker-street and Rickmansworth.

It embodies many new structural features and is divided into three compartments, each connected by a corridor and each with distinctive decorative schemes.

In all three schemes a modern note is introduced and an effort has been made to create a cheerful and comfortable atmosphere. One compartment is panelled in blue and bronze coloured aluminium bounded by natural oak woodwork; in another compartment Perspex panels containing orange-coloured fabric framed by "lacewood" woodwork are employed, and in the third compartment effective use is made of a combination of "Sundeala" board and open mesh cotton net in cerulean blue and orange. The woodwork here is also of "lacewood."

Spaciousness is created by arranging the seats across the compartments, some against the partitions and the remainder forming an island in the middle of the compartments. Opposite each doorway an avenue is provided so that there is ample room for passengers to move about or to stand during rush hours.

Other innovations common to each compartment are luggage racks over the seats, push buttons, which enable passengers to open or close the doors, and, to round off a really modern layout, fluorescent lighting by Osram warm-white fluorescent lamps.

Fig. 1. A view of a new coach, equipped with fluorescent lighting.

These are operated from an A.C. source with a periodicity of 1,200 cycles. This relatively high frequency not only allows the use of small chokes, it permits automatic starting without the use of a starter switch, it eliminates the

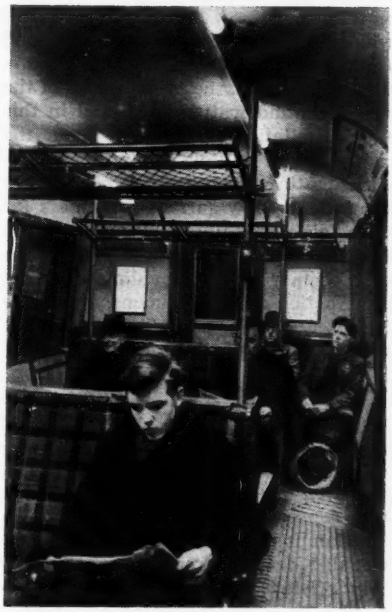

Fig. 2. Another view, giving a good impression of the faces.

stroboscopic effect, and it also improves lamp efficiency. The elimination of the starter switch also reduces maintenance, which, of course, is an attractive feature to transport undertakings.

The decision to use fluorescent lamps, however, was far easier to make than to accomplish, and it was necessary to instal a motor alternator. This alternator is of the inductor type, and is driven from a motor running off the 600 Volt D.C. traction supply. It is designed to feed two coaches, and since only one is at present in use, an additional choke enables it to run at half load.

It should be mentioned here that extensive experiments on the District Railway with D.C. operated fluorescent lamps had enabled the engineers of the L.P.T.B. to overcome all the difficulties of installation and maintenance and to ascertain the fitness of this type of lighting for underground trains. In these experiments also 20-watt Osram warm-white fluorescent lamps, each 2 ft. long by 1½ in. diameter, had proved quite satisfactory, and, therefore, lamps of the same size and wattage are used in this A.C. installation. They give about the right amount of light for uniform illumination throughout the coach, and have a sufficiently low surface brightness for them to be used unscreened. There are 24 fluorescent lamps altogether (eight in each compartment), providing an initial illumination of 10/15 lumens per square foot at 2 ft. 6 in. from the floor. They are mounted in fittings designed by the L.P.T.B. and, as the illustrations show, they harmonise exceptionally well with the general design and decorative schemes of the coach.

Compared with the tungsten lamp installation of equivalent light output, the heat generated by these Osram fluorescent lamps is much lower, and this is a valuable feature from the passengers' point of view, especially during the rush-hour periods when crowding is prevalent.

Throughout all the experiments associated with this coach the G.E.C. has been in close collaboration with the L.P.T.B. and with Metropolitan Vickers, Ltd., who are responsible for the design of the motor alternator.

Industrial Fluorescent Lighting

A good example of industrial fluorescent lighting is afforded in a section of their fittings and assembly shops of the Elswick Works of Messrs. Vickers Armstrong, Ltd., Here 80-watt 5-ft. fluorescent lamps have been installed in three rows, mounted directly on the ceiling 14 ft. high in Metrovick continuous troughing. The well diffused

A view of a section of the Elswick Works of Messrs. Vickers Armstrong, Ltd., in which fluorescent lighting has been installed

nature of the lighting and the low brightness of the sources of light are of special benefit in view of the fact that the pumps and gear manufactured consist of highly polishable components. Modern interior decoration is also a feature; contrast-brightness being reduced to an agreeable figure and a clean and cheerful appearance secured. The nature of the general lighting also enables floor space to be utilised to the fullest extent and permits the efficient arrangement of machinery and work benches.

The accompanying illustration gives a good idea of the effectiveness of the lighting.

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Lighting Education for the Army

At the instigation of the Education Officer, 28 Group Pioneer Corps, a three-day lighting refresher course for men shortly to return to the electrical industry was held at the Lighting Service Bureau on February 20, 21, and 22, 1946.

The men, who attended in Army time, represented the R.E.M.E., the R.A.O.C., and the Pioneer Corps, and heard talks closely corresponding to the programme of a normal Bureau Illumination Design Course.

The photograph shows the audience at the conclusion of the course.

Although the Lighting Service Bureau has a very full programme for the rest of this year, it is most anxious to do everything possible to assist men in all branches of the Forces to prepare themselves for the return to civil life. It is possible, therefore, that further courses

of this nature may be arranged. Any suggestions from Forces Education Officers will be most welcome and should be addressed to the Acting Manager, The Lighting Service Bureau, 2, Savoy Hill, London, W.C.2.

Fluorescent Lighting Welcomed in a Cotton Mill

(Communicated)

In August last, the Directors of John Broadbent and Sons, Ltd., Oakfield Mill, Droylsden, Manchester, decided that the artificial lighting of the card room could be improved to make work in that department more attractive, and with a view to encouraging recruits.

The Manchester Branch of Siemens Electric Lamps and Supplies, Limited, were consulted and submitted a scheme for fluorescent lighting of the card room, designed to give a general overall lighting intensity of 8-10 foot candles in accordance with the recommendations of the I.E.S. Code.

The card room contains forty-four carding engines together with draw-frames, slubbing frames, and intermediate frames, and it is one of the first card rooms in the Cotton Industry to be completely equipped with fluorescent lighting.

In general "Sieray" FTF.9180 reflectors were employed—(see figure 1) —but because of difficulties in avoiding complicated overhead drive mechanism it was necessary to use type FTF.9168 2-tube fittings over the draw-frames —(see figure 2). All fittings are

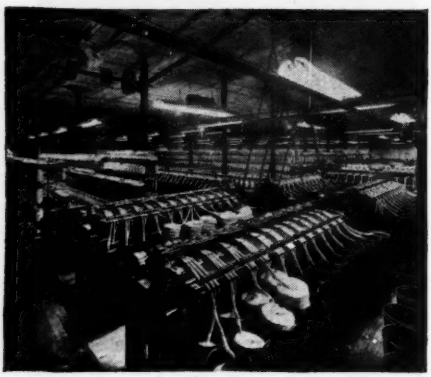


Fig. 2.

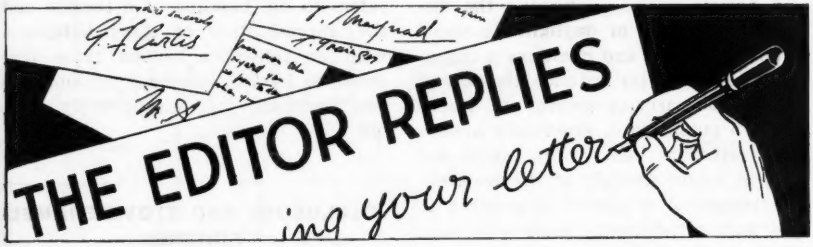
Fig. 1.

mounted at a height of 9-ft. and in all 130 5-ft. "Sieray" "Daylight" tubular lamps were employed. Adjacent single-lamp tube fittings are connected on different phases of the supply system and this, together with the "twin lamp circuit" employed in the 2-tube fittings, obviates the small amount of stroboscopic effect sometimes noticed with fluorescent lamps.

In order to eliminate the possibility of any vibration, specially designed springs were incorporated in the suspension of the fittings. The suspension was achieved by means of single strand steel wire to avoid the collection of cotton "fly."

The card room operatives find the new system of lighting a big improvement on the old gas-filled lamps. The lighting, which is the nearest approach to natural daylight and causes little or no shadow, helps to make their work easier and they have found it less strain on the eyes.

The electrical contracting work was carried out by Messrs. J. R. Halliwell, Ltd., of 193, Hart-road, Manchester.



Several matters discussed in our January issue (pp. 12-13) have brought me letters and inquires. I have had a letter from Dr. W. Geiss Eindhoven (from whom I am delighted to hear again), who points out, more in sorrow than in anger, a slip in my reference to the **regulation prescribing yellow headlights.** It was, I understand, the *French* Government, and not the Dutch, who erred in this respect.

The reference at the foot of p. 13 to the engagement of Mr. S. A. Lay as **lighting expert** to the Courtauld interests has excited no little interest and is regarded as an encouraging precedent. It has been, however, suggested that whilst such an important firm, with such wide interests, can certainly find room for the service of a lighting expert, opportunities may be less limited in many cases, or at least they may become so: in other words, after certain initial schemes have received attention the duties may ultimately resolve themselves largely into **maintenance problems.**

I do not think that this is likely to happen in the case of bodies and firms of any size and in a state of development. On all the large railway systems, and likewise in docks, though the maintenance work is certainly heavy there must be endless **new work awaiting the lighting engineer** that *ought* to be done (whether it *will* be done is perhaps another matter). For some time to come lighting engineers in such positions may have to fight an uphill battle. The tendency to make the best of what exists, and to maintain it even in a state of comparative inefficiency, seems to be deep-rooted in human nature.

It is also reasonable to assume that in the case of manufacturing firms with fairly wide interests **the special knowledge of a lighting expert,** well versed in optics as well as illumination, should prove useful in the development of some of their products, as well as in attending to their lighting. Concerns that make use of display to attract custom, again, cannot rest content with the maintenance of existing conditions. They must always be seeking new ideas.

Finally, there is, at the moment, the special consideration that **for six long years all lighting has been at a standstill,** except in factories devoted to war work or offices likewise engaged on essential national work. There should, therefore, be plenty of new projects for many years to come, and it will be beneficial to large consumers to have available **their own experts** who can devise plans and prepare specifications, and thus free them from relying exclusively on firms in the lighting industry for such services.

Mr. A. Cunnington (who, incidentally, from his experience on railways, could

doubtless endorse much that has been said above) writes confirming **the disturbing influence of daylight** discussed in our last issue, and mentions a cogent example. Take, for instance, the case of **a long arch** carrying several rail tracks across a public yard, practically always under artificial light at its centre but open to bright sunlight at its two ends. The transition is almost impossible to deal with satisfactorily from a lighting standpoint; in fact, in the case mentioned, there was actually a fatal accident due to inability to see clearly in the central region owing to excessive brightness at the two ends. The problem is a familiar one **in subways**, and in some of those carrying heavy traffic has been partially met by grading the artificial illumination at the ends, where the subway emerges into daylight.

These effects of daylight are often unperceived and imperfectly understood. There is on record the case of a deputation from a Local Council who had received complaints about the poor lighting of a certain arch and—perhaps quite naturally—arranged an appointment to visit it after dark, when they could see little wrong. It was only when they were persuaded to repeat their visit during the daytime that they made the discovery that, paradoxically, sunlight was to blame for the complaint.

It has been announced that a popular talk by Mr. R. A. Eshelby on **"Lighting in Captivity"** is to form one of the items on the opening evening of the I.E.S. Convention. This should prove an interesting feature. In the meantime I have seen a letter from another I.E.S. member. Mr. J. Silverston, who seems to have had a somewhat similar experience in Prisoners' Camps, and describes the efforts of himself and his friends to continue their technical studies under most difficult conditions. Mr. Silverston also refers to the building of a theatre and the improvisation of **stage lighting**—with no reflectors beyond those that could be hastily contrived by adapting tins previously containing bully beef, etc.

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